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<p>(21) International Application Number: PCT/FI99/00420 (22) International Filing Date: 17 May 1999 (17.05.99) (30) Priority Data: 981111 19 May 1998 (19.05.98) FI (71) Applicant (for all designated States except US): VALMET CORPORATION [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): TOIVANEN, Heikki [FI/FI]; Pitkäläntie 10, FIN-40950 Muurame (FI). ESKELI-NEN, Ilkka [FI/FI]; Kipparinpolku 9, FIN-78300 Varkaus (FI). (74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).</p>		<p>(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report.</p>
<p>(54) Title: EQUIPMENT AND METHOD FOR REPLACING A BAND-LIKE DOCTOR BLADE</p> <div data-bbox="487 1134 1104 1638"> </div> <p>(57) Abstract</p> <p>The invention concerns an equipment for replacing a doctor blade, a doctor blade, and a method in the use of band-like doctor blade. The equipment for replacing a doctor blade comprises a doctor blade (11) placed in a reel, which doctor blade can be fed into the blade holder (14) for the doctor blade. The blade holder (14) for the doctor blade (11) comprises locking devices in its connection for locking the doctor blade (11) in the blade holder. The equipment comprises a doctor blade (11) which comprises notches (18a1, 18a2...) at the edge, the doctor blade being fed over a length equal to the distance (E₁) between the notches at the edge, while the notches (18a1, 18a2) at the edge are placed, during operation of the doctor blade (11), at both ends of the blade holder (14) and permit bending of the band-like doctor blade (11) in the way of a normal blade in an operating situation.</p>		

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Equipment and method for replacing a band-like doctor blade.

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The invention concerns an equipment for replacing a doctor blade, a doctor blade, and a method in the use of a band-like doctor blade.

10 For example, from the *patent publications FI 54,076 and US 4,691,406*, the use of a band-like doctor blade material is known for servicing of roll faces. Thus, it is known to transfer a used doctor blade onto a winder for the used blade, and the unused doctor blade is fed from its own reel. The prior-art equipments are mainly hydraulic, and in their case oscillation of a doctor blade has also been permitted.

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In the prior art devices, however, it is a particular drawback that the contact between the doctor blade and the roll is not fully adequate, because at the edges of the holder the doctor blade is bent in an uncontrolled way, and in such a case the wear of the doctor blade is also uncontrolled, which has the further consequence that the operation of the doctor blade in the prior-art solutions is not sufficiently reliable.

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In the present patent application, it is suggested that such an equipment for replacing a doctor blade is used in which the doctor blade is passed from a reel of doctor blades, preferably from a storage box for doctor blades. Thus, at one end of the roll, the equipment comprises a blade feed device, and at the opposite end of the roll a blade pulling device. Both of said devices are operated when a blade is fed from a reel of doctor blades into connection with the roll. The doctor blade is passed into a blade opening of a blade holder for a conventional doctor blade, which holder is provided on a frame beam, and the blade is locked in its position in the blade opening by means of loading hoses which operate as a blade positioning device and, at the same time, as locking means.

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In accordance with the present invention, it is an essential feature of the equipment for replacing a doctor blade and of the doctor blade and of the method in the use of the doctor blade in accordance with the present invention that the doctor blade is provided with edge notches at one longitudinal edge of the doctor blade. During
5 operation of the doctor, said notches are placed at both ends of the area of use proper of the doctor blade. The notches permit controlled and uniform bending of the doctor blade during operation. In such a case, the blade is worn uniformly. When it is desirable to change the area of operation of said doctor blade, doctor blade is fed from the reel of doctor blades so that the edge notch at the outlet side
10 of the doctor blade is placed at the end of the area of operation on the doctor blade holder, and the new edge notch is transferred in such a way into connection with the blade that it is placed at the inlet end of the doctor blade holder, as viewed in the feed direction L_1 . Thus, the doctor blade is fed periodically always over the length of one distance E_1 between notches.

15 From the blade pulling device the used doctor blade is fed further to the winding device for used blade.

The blade solution in accordance with the invention mentioned above makes it
20 possible to provide an equipment of an entirely novel type for replacing a doctor blade. In accordance with the invention, a band-like doctor blade can be fed directly out of a storage package for doctor blades from a reel, and said feed is carried out periodically always over the length of one distance E_1 between notches. Thus, a blade in accordance with the invention is provided with notches at the side or edge,
25 which notches permit satisfactory operation of the blade in accordance with the invention. In accordance with the invention, it is possible to use existing frame beams and doctor blade holders of a doctor equipment. In such a case, the blade is fed through the blade opening on the holder, at which time the blade loading members have been released. As the loading means, it is possible to use ordinary
30 pneumatic hoses or equivalent. Also, other loading means can be used in order to lock the doctor blade in its holder.

The equipment for replacing a doctor blade, the doctor blade, and the method in the use of a band-like doctor blade in accordance with the invention are characterized in what is stated in the patent claims.

- 5 The invention will be described in the following with reference to some preferred embodiments of the invention illustrated in the figures in the accompanying drawings, the invention being, yet, not supposed to be confined to said embodiments alone.
- 10 Figure 1A is a schematic illustration of an equipment in accordance with the invention as viewed in the machine direction.

Figure 1B is a side view of a doctor blade.

- 15 Figure 1C shows the equipment of Fig. 1B as viewed in the direction of the arrow k_1 in Fig. 1B.

Figure 2A shows a doctor blade in accordance with the invention.

- 20 Figure 2B is a sectional view of a doctor blade taken along the line I—I in Fig. 2A.

Figure 3A is an axonometric view illustrating the feed of a doctor blade in accordance with the invention while making use of a photocell.

- 25 Figure 3B is a side view of a feed device 12.

Figure 3C shows an embodiment in which the position of the edge notch is read from the location of the edge notch by means of a photocell device $50a_1, 50a_2$.

- 30 Figure 3D shows a second embodiment of the invention, in which the feed device comprises a gearwheel, a toothed wheel, or equivalent.

Figure 3E shows an embodiment of a doctor blade related to the embodiment shown in Fig. 3D, in which embodiment the doctor blade is provided with perforations M_1 , M_2 ... for engagement with the teeth.

- 5 Figure 4 is a schematic illustration of a solution of equipment in accordance with the invention.

Fig. 1A shows an equipment 10 in accordance with the invention for replacing a doctor blade. The doctor blade 11 is placed on a reel 100 in a storage box P, from which it is taken as a band to a feed device 12 and passed through the feed device 12 and through a blade opening provided in the blade holder 14 provided on the doctor blade frame 13 further to a pulling device 16 and through it to a winding device 17 for used doctor blade.

- 15 In the figure, the direction of feed of the doctor blade 11 from the blade feed device 12 through the blade holder 14 to the pulling device 16 is denoted with the arrow L_1 . Thus, the doctor blade is fed from the tending side H of the machine to the driving side K of the machine along with the face T' of the roll T. Between the frame of the doctor and the blade holder, there are means J_1, J_2 , favourably loading hoses, by whose means the blade holder 14 provided on the frame can be pivoted so that the doctor blade 11 fitted in the blade holder reaches contact with the roll T face T'. In this connection, the blade 11 is also kept locked in its blade holder 14.

- 25 The frame 13 of the doctor blade, i.e. the doctor frame, can be oscillated by means of a cylinder device 15 (arrow S_1). By means of the loading hoses J_1, J_2 , which are loaded by a pressure of a medium, the blade can be pressed so that the loading hose presses the doctor blade 11 into contact with the faces of the holder 14 and keeps the blade locked in the holder.

- 30 Fig. 1B is a side view of the blade holder, and Fig. 1C shows the equipment as viewed in the direction of the arrow k_1 in Fig. 1B. The holder 14 of the doctor blade 11 is fitted on the doctor frame 13, which has been mounted by means of

bearing means G_1, G_2 . In an oscillating movement, the whole doctor frame 13 is displaced along a linear path (arrow S_1). The equipment 10 in accordance with the invention for replacing a doctor blade 11 can be used in connection with existing doctor frames 13 and their blade holders 14. The doctor frames 13 can be provided with oscillating devices 15, in which case, in a solution of equipment in accordance with the invention, the doctor blade frame 13 and, thus, the doctor blade 11 can be oscillated in the lateral direction of the roll T, in which connection, for example, a movement of oscillation of 100 mm is permitted so that the blade feed device and the blade pulling device are coupled free. A controlled bending of the blade 11 is permitted by notches $18a_1, 18a_2 \dots$ at the edge, and in this way a movement of oscillation is also permitted.

Fig. 2A illustrates a blade 11 in accordance with the invention. The blade 11 is provided with notches $18a_1, 18a_2 \dots$ at the edge, and the distance between said notches, i.e. the gap E_1 between the notches, is equal to the length of the roll T. In such a case, the notches $18a_1, 18a_2 \dots$ at the edge can be fitted outside the two lateral edges of the blade holder. The notches at the edge permit bending of the blade 11 and, thus, uniform wear.

The notches $18a_1$ and $18a_2$ at the edge are preferably of rectangular section, and their depth, i.e. height, $= d_1$, and their width $= d_2$, and the gap E_1 between the notches is preferably equal to the length of the roll T, i.e. preferably the length over which the doctor blade must be in contact with the roll face T' in view of its servicing.

The gap E_1 between the notches is preferably in a range 1000 mm ... 15,000 mm. The depth d_1 of each notch $18a_1, 18a_2 \dots$ at the edge is preferably in a range 5 mm ... 100 mm, and the width d_2 of each notch $18a_1, 18a_2 \dots$ at the edge is preferably in a range 5 mm ... 1200 mm, and optimally in a range 100 mm ... 1000 mm.

Fig. 2B shows the doctor blade 11 as a sectional view taken along the line I—I in Fig. 2A. In the embodiment shown in the figure, the doctor blade 11 is a web-like, oblong material to be unwound from a reel, which material comprises a blade edge 11a which is placed against the roll face and fitted at an oblique angle against the roll face. Further, on the top face of the doctor blade 11, there are pins 60a₁, 60a₂..., by whose means it is prevented that the doctor blade should fall away from the gap in the blade holder when the doctor blade is not loaded and when the blade is in a position in which it can fall away from the blade space of the blade holder by the effect of gravity.

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Fig. 3A shows an embodiment of the invention in which the equipment is controlled by means of a system of photocells. Further, for the feed of the doctor blade 11, a feed device 12 and a pulling device 16 are used, which comprise friction wheels 12a₁, 12a₂; 16a₁, 16a₂. Thus, the feed device and the pulling device form a friction equipment, in the way shown in Fig. 3A, for feeding the doctor blade 11 in the feed direction L₁. In the way shown in Fig. 3A, when the edge notch 18a₁ at the blade 11 reaches the location of the photocell device 50, the feed is stopped. The photocell device 50 comprises a source of light 50a₁ and a detector 50a₂ that receives light. In such a case, the notches 18a₁ and 18a₂ at the edge are placed at the ends H and K of the blade holder 14 of the doctor blade 11. The blade is always fed as a length equal to the gap E₁ between the edge notches 18a₁ and 18a₂, i.e. as a length over which the doctor blade 11 is in contact with the roll T face T'. The friction wheels 12a₁ and 16a₁ are rotated by electric motors. The backup wheels 12a₂ and 16a₂ can be freely revolving.

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Fig. 3B illustrates the construction of the feed device 12. The feed device 12 comprises feed wheels 12a₁, 12a₂, preferably friction wheels, of which preferably the friction wheel 12a₁ is provided with drive. The drive is taken favourably from an electric motor. The oblong doctor blade band 11 is passed through the nip between the wheels 12a₁, 12a₂ and is fed forwards by means of the wheel 12a₁. The feed direction is indicated by the arrow L₁. The gap E₁ between notches, i.e. the distance

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between adjacent notches $18a_1, 18a_2 \dots$ at the edge, is in a range 1000 mm ... 15,000 mm, depending on the length of the roll.

Fig. 3C is a separate illustration showing the determination of the position of the doctor blade 11 by means of a photocell device 50. The photocell device comprises arrangements of equipment fitted above and below the blade 11, i.e. a transmitter of a signal, preferably a source of light $50a_1$ which emits light, and a detector $50a_2$ which detects light, in the present case preferably a photocell. When the notch $18a_1$ at the edge of the blade 11 has reached the location of the photocell device, said situation is detected by means of the detector $50a_2$, and the feed of the blade 11 is stopped. Then, the detector $50a_2$ receives a signal, preferably a beam of light, from the signal transmitter $50a_1$, preferably a source of light. The information from the detector $50a_2$ is transferred to the central unit 200, as is illustrated in Fig. 4.

Fig. 3D shows a second embodiment, in which the doctor blade is provided with holes $M_1, M_2, M_3 \dots$, which are placed at regular distances from one another and which operate as grasping holes for the blade 11 feed device 12 and for the blade pulling device 16, which devices comprise teeth on the drive wheels $12a_1, 16a_1$, the teeth $c_1, c_2 \dots$ in the toothings entering into said holes $M_1, M_2 \dots$ and operating as blade 11 feeders. A solution of said sort also permits reliable calculation of the blade length that has been fed, because the blade 11 feed device 12 can comprise a detector device on the drive wheel $12a_1$, by means of which detector device the distance of blade that has been fed can be calculated from the number of revolutions of the drive wheel of the feed device 12.

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Fig. 3E is a separate illustration showing an embodiment of the invention which is related to Fig. 3D, i.e. to the toothed-wheel drive. In the embodiment shown in Fig. 3E, the lateral area of the band 11 is provided with notches M_1, M_2 which are grasped by the teeth on the toothed wheel $12a_1$ so as to feed the doctor blade 11 in the feed direction.

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Fig. 4 is a schematic illustration of a solution of equipment in accordance with the invention. The central unit 200 comprises data transfer buses $e_1, e_2 \dots$ passing to the blade feed device 12 and to the blade pulling device 16 and to the winder 17 of used blade 11.

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The notch gap E_1 between the edge notches $18a_1, 18a_2$ can be favourably programmed in advance in the central unit 200, in which case the central unit 200 is provided with a counter, by whose means it sums the blade length that has been fed and compares it with the blade length provided on the reel and notifies the operating
10 personnel, by means of a display monitor or otherwise, of the necessity of replacing a new reel of doctor blades or of the total blade length still present on the reel.

Claims

1. An equipment for replacing a doctor blade (11), which equipment comprises a doctor blade (11) placed in a reel, which doctor blade can be fed into the blade holder (14) for the doctor blade, **characterized** in that the equipment comprises a doctor blade (11) which comprises notches (18a₁, 18a₂...) at the edge, the doctor blade being fed over a length equal to the distance (E₁) between the notches at the edge, while the notches (18a₁, 18a₂) at the edge are placed, during operation of the doctor blade (11), at both ends of the blade holder (14) and permit bending of the band-like doctor blade (11) in the way of a normal blade in an operating situation.
2. An equipment as claimed in claim 1, **characterized** in that the equipment comprises a doctor blade feed device (12) and a pulling device (16), by whose means the doctor blade (11) is fed in the feed direction (L₁) from a storage box (P) for doctor blade to the winding device (17) of used doctor blade (11).
3. An equipment as claimed in any of the preceding claims, **characterized** in that, in view of displacing the doctor blade (11), there is a doctor blade (11) feed device (12) and a pulling device (16), which comprise drive wheels operating by friction and which are brought into engagement with the face of the web-like doctor blade (11) in order to feed the blade in the feed direction (L₁).
4. An equipment as claimed in any of the preceding claims, **characterized** in that, at the edge of the doctor blade (11), there is a source of signals (50a₁) and a detector (50a₂) for detecting of signals, which signal is detected by the detector (50a₂) when an edge notch (18a₁, 18a₂...) at the doctor blade (11) has reached the location of the source of signals (50a₁), in which connection the feed of the doctor blade (11) is stopped, and that the source of signals (50a₁) is preferably a signal emitted by a beam of light, which signal is received by a photocell (50a₂).

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5. An equipment as claimed in any of the preceding claims, **characterized** in that the drive wheels of the doctor blade feed device (12) and of the pulling device (16) operate electrically.

5 6. A doctor blade, **characterized** in that the doctor blade (11) is a band-like construction and comprises edge notches ($18a_1, 18a_2 \dots$) at an edge of the blade (11), the distance between the notches ($18a_1, 18a_2 \dots$) at the edge being determined by the length of the roll, i.e. by the length over which the doctor blade (11) is in contact with the roll face (T') of the roll (T) to be serviced.

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7. A doctor blade as claimed in claim 6, **characterized** in that the distance (E_1) between the edge notches ($18a_1, 18a_2$) is in a range 1000 mm ... 15,000 mm.

8. A doctor blade as claimed in any of the preceding claims, **characterized** in that
15 the notch edge ($18a_1, 18a_2 \dots$) is a rectangular notch, whose depth (d_1) is in a range 5 mm ... 100 mm, and whose width (d_2) is in a range 5 mm ... 1200 mm.

9. A doctor blade as claimed in claim 8, **characterized** in that the width (d_2) of the edge notch ($18a_1, 18a_2 \dots$) is optimally in a range 100 mm ... 1000 mm.

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10. A doctor blade as claimed in any of the preceding claims, **characterized** in that the doctor blade (11) comprises guide pins ($60a_1, 60a_2 \dots$) on its face, by means of which guide pins the doctor blade (11) is kept in the blade holder (14), and that the guide pins ($60a_1, 60a_2 \dots$) have been fitted onto the doctor blade (11) before the blade
25 has been wound onto the reel (100) and placed into the storage box (P).

11. A method in the use of a band-like doctor blade (11), **characterized** in that, in the method, the doctor blade (11) is fed from a reel (100) into a blade holder (14) and that, in the method, a doctor blade (11) is used which comprises edge notches
30 ($18a_1, 18a_2 \dots$) at its edge, the distance (E_1) between the edge notches being the length over which the doctor blade is fed in the feed direction (L_1).

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12. A method as claimed in the preceding claim, **characterized** in that the doctor blade is fed in the feed direction (L_1) from a reel out of a doctor blade (11) storage box (P).

5 13. A method as claimed in claim 11 or 12, **characterized** in that, in the method, the used doctor blade (11) is wound by means of a winding device (17) for used doctor blade (11).

10 14. A method as claimed in any of the preceding claims 11 to 13, **characterized** in that, in the method, a detector ($50a_2$) is used, which has been fitted in the lateral area of the doctor blade, in which connection, in the method, the detector ($50a_2$) detects the edge notch ($18a_1$ or $18a_2...$) provided at the edge of the doctor blade (11) and reports it to the central unit (200) of the device, in which case the feed of the doctor blade (11) is stopped.

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15. A method as claimed in the preceding claim, **characterized** in that a combination of a source of light ($50a_1$) and a detector ($50a_2$) is used, in which connection, at the edge notch ($18a_1, 18a_2...$), the beam of light or equivalent is detected by the detector ($50a_2$) while the detecting apparatus is fitted in the lateral area in which the
20 edge notch ($18a_1...$) of the blade (11) is placed.

16. A method as claimed in any of the preceding claims 11 to 14, **characterized** in that the doctor blade (11) is transferred by means of a friction equipment ($12a_1, 12a_2; 16a_1, 16a_2$).

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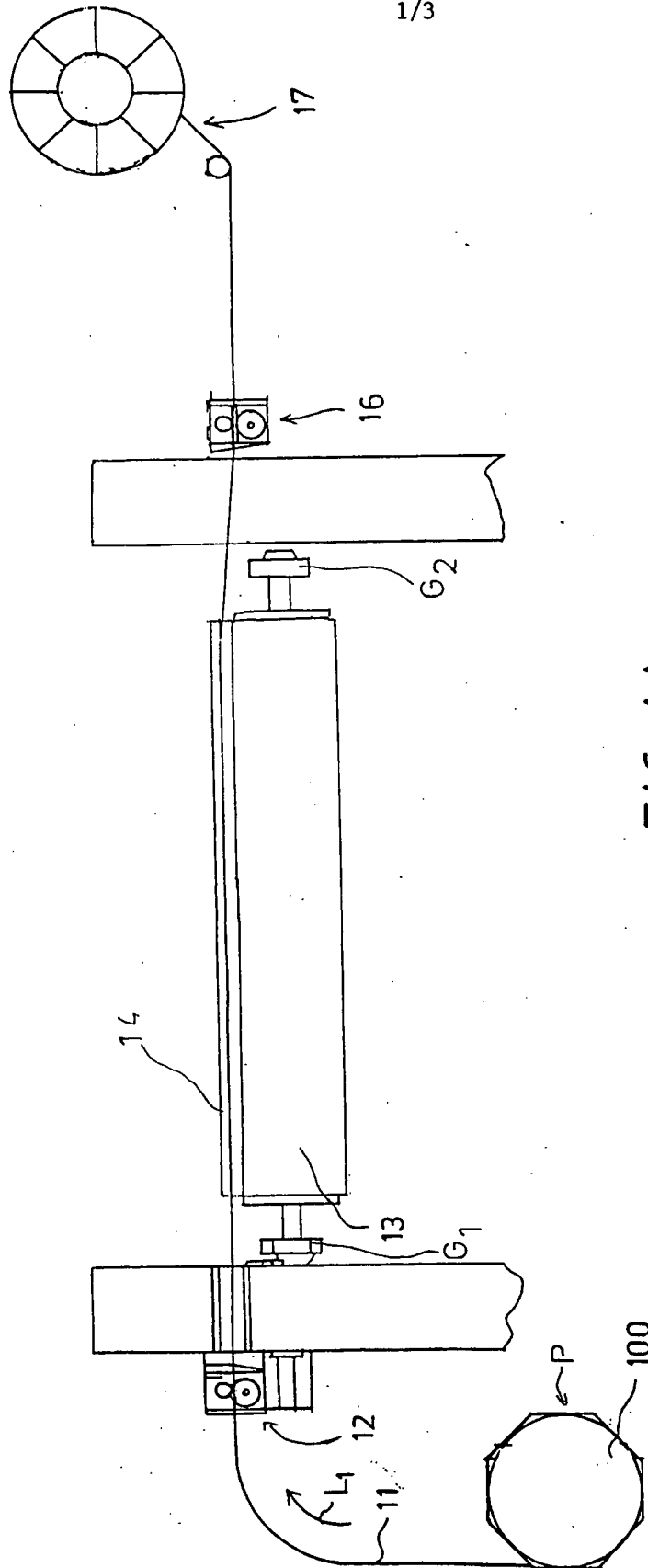
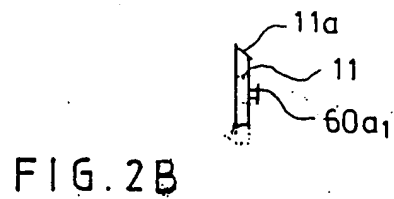
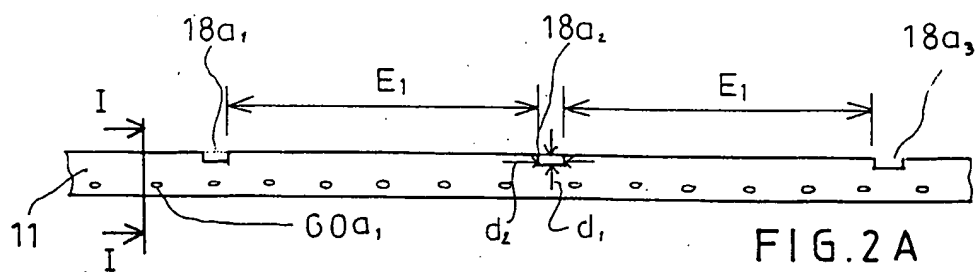
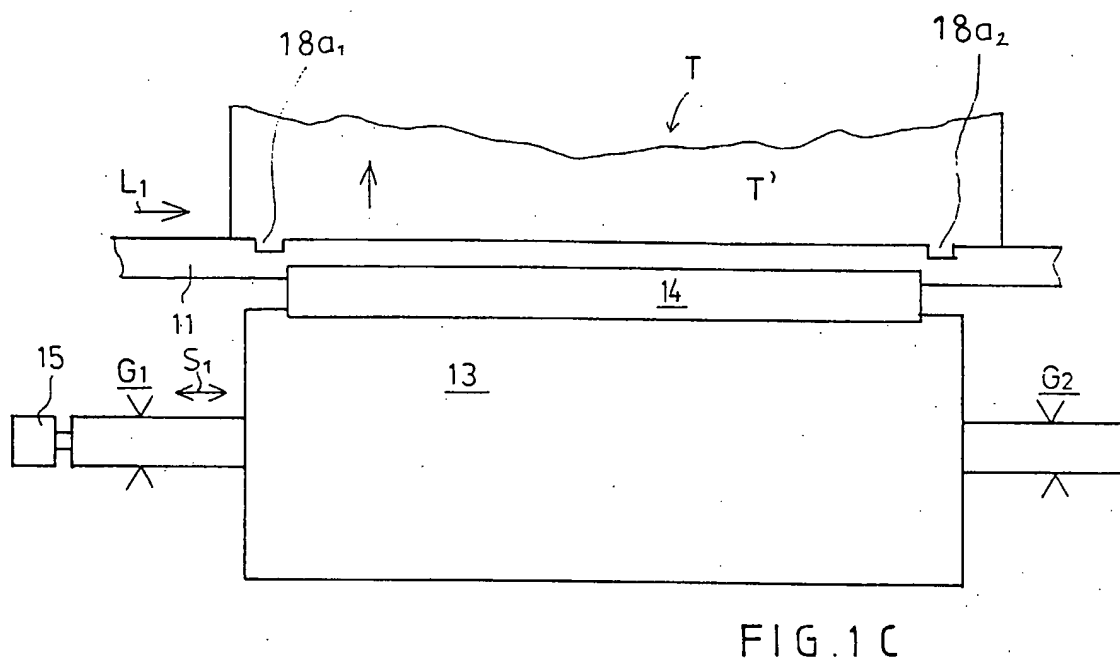
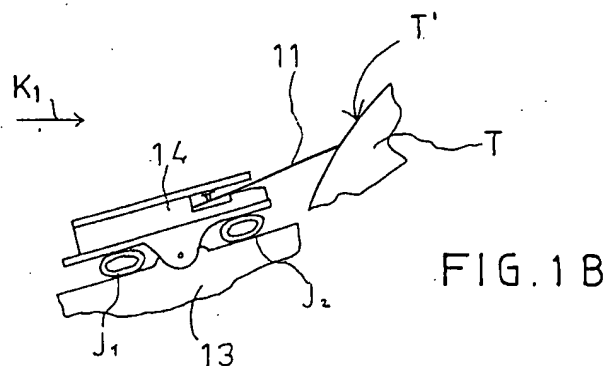


FIG. 1A



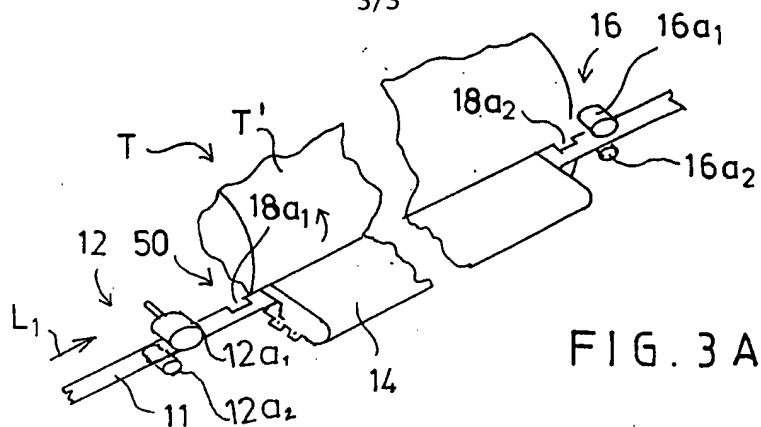


FIG. 3A

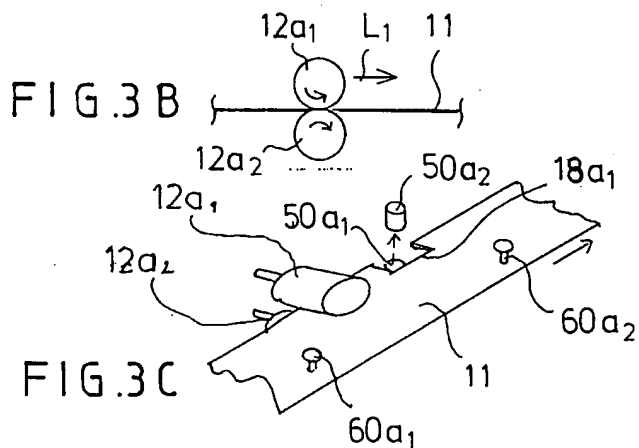


FIG. 3B

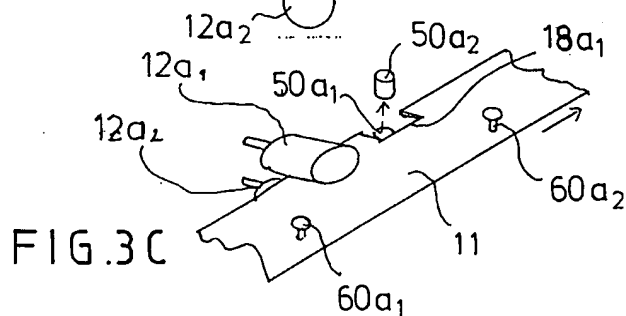


FIG. 3C

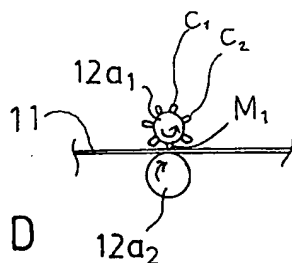


FIG. 3D

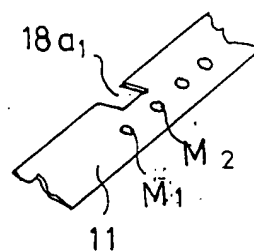


FIG. 3E

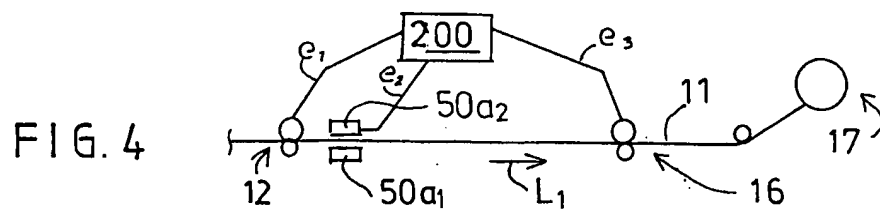


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00420

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21G 3/00, B05C 11/04, B41F 9/10, B31F 1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21G, B05C, B31F, B41F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	US 5782976 A (MICHAEL LAWRENCE MARZIALE ET AL), 21 July 1998 (21.07.98), column 2, line 24 - line 55, figures 3,4, abstract --	1-16
A	US 5264035 A (RUDOLF BEISSWANGER ET AL), 23 November 1991 (23.11.91), figures 6,9, abstract --	1-16
A	US 5138740 A (RONALD F. GOODNOW ET AL), 18 August 1992 (18.08.92), figures 2,4, claim 1 -- -----	1-16

☐ Further documents are listed in the continuation of Box C.
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Information on patent family members

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